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This public health statement tells you about hydrogen sulfide and the effects of exposure. The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Hydrogen sulfide has been found in at least 29 of the 1,467 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which hydrogen sulfide is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact.

If you are exposed to hydrogen sulfide, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS HYDROGEN SULFIDE?

Hydrogen sulfide is a colorless, flammable gas under normal conditions. It is commonly known as hydrosulfuric acid, stink damp, and sewer gas. Hydrogen sulfide smells like rotten eggs. People can smell hydrogen sulfide at concentrations as low as 0.5 parts of hydrogen sulfide per billion parts of air (ppb, 1 ppb is 1,000 times less than 1 part per million [ppm]). However, at concentrations over 100 ppm most people can no longer smell hydrogen sulfide, which makes it very

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dangerous. Hydrogen sulfide is found naturally and is also produced from man-made processes. It is found naturally in crude petroleum, natural gas, volcanic gases, and hot springs and is often the result of bacterial breakdown of organic matter. It is also produced from human and animal waste and can be found in sewage treatment facilities, sediments of fish aquaculture, and in livestock barns or manure areas. Industrial sources of hydrogen sulfide include petroleum refineries, natural gas plants, petrochemical plants, coke oven plants, kraft paper mills, food processing plants, and tanneries. Hydrogen sulfide is also produced by bacteria found in your mouth and gastrointestinal tract, and by enzymes in your brain and muscle. You will find more about hydrogen sulfide in Chapters 3 and 4.

1.2 WHAT HAPPENS TO HYDROGEN SULFIDE WHEN IT ENTERS THE ENVIRONMENT?

Hydrogen sulfide is released primarily as a gas and will spread in the air. However, in some instances, it may be released in the liquid waste of an industrial facility. When hydrogen sulfide is released as a gas, it may form sulfur dioxide and sulfuric acid in the atmosphere. Sulfur dioxide can be further broken down and is a major contributor to acid rain. Hydrogen sulfide is estimated to remain in the atmosphere for an average of 18 hours You will find more about what happens to hydrogen sulfide when it enters the environment in Chapters 4 and 5.

1.3 HOW MIGHT I BE EXPOSED TO HYDROGEN SULFIDE?

Your body makes small amounts of hydrogen sulfide. In the mouth, air levels between 1 and 100 parts of hydrogen sulfide per billion parts of air (ppb) have been found, while the average levels recorded in intestinal gas have been between 1 and 4 parts per million (ppm). The levels of hydrogen sulfide found in air and water are typically low. The amount of hydrogen sulfide in the air in the United States is between 0.11 and 0.33 ppb. In undeveloped areas of the United States, concentrations have been reported to be between 0.02 and 0.07 ppb. The amount of hydrogen sulfide found in surface water is low because hydrogen sulfide readily evaporates from water. Groundwater concentrations of hydrogen sulfide are generally less than 1 ppm; however measured sulfur concentrations in surface and waste waters have ranged from slightly less than 1 to 5 ppm.

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The general population may be exposed to quite high levels of hydrogen sulfide through misuse of drain cleaning materials and to lower levels from the accidental or deliberate release of emissions from pulp and paper mills, natural gas drilling and refining operations, and in areas with high geothermal activity, such as hot springs.

Persons who work in certain industries can be exposed to higher levels of hydrogen sulfide than the general population. These industries include the manufacture of rayon textiles, pulp and paper mills, petroleum and natural gas drilling operations, and waste-water treatment plants. Workers on farms with manure storage pits or landfills can also be exposed to higher levels of hydrogen sulfide than the general population. As a member of the general public you may be exposed to higher-than-normal levels of hydrogen sulfide if you live near a waste-water treatment plant, a gas and oil drilling operation, a farm with manure storage or livestock confinement facilities, or a landfill. Exposure from these sources is mainly from breathing air that contains hydrogen sulfide. You will find further information about hydrogen sulfide exposure in Chapter 5.

1.4 HOW CAN HYDROGEN SULFIDE ENTER AND LEAVE MY BODY?

Hydrogen sulfide enters your body primarily through the air you breathe. It can also be absorbed through the gastrointestinal tract and the skin. Once hydrogen sulfide enters your body several things can happen. Hydrogen sulfide may be broken down into more simple compounds, it may interact with proteins within your body, or it may leave unchanged. When hydrogen sulfide is broken down, it is partly excreted in the urine. Hydrogen sulfide that is not broken down is excreted through the lungs and feces. Additional information on how hydrogen sulfide can enter or leave your body is discussed in detail in Chapter 2.

1.5 HOW CAN HYDROGEN SULFIDE AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

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One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Breathing hydrogen sulfide at concentrations greater than 500 ppm can be fatal within just a few breaths. Death is usually preceded by a loss of consciousness after one or more breaths, although a loss of consciousness does not necessarily mean that death will follow. Hydrogen sulfide is considered to be a “broad spectrum’ poison. This means that it can poison several different systems in the body. This variety of activity may be the reason that no single antidote, or treatment, has been found for hydrogen sulfide poisoning. Hydrogen sulfide can be especially dangerous because at concentrations over 100 ppm you might not be able to smell it, and therefore you would not realize that you were being overexposed. Deaths due to breathing in large amounts of hydrogen sulfide have been reported in a variety of different work settings, including sewers, animal processing plants, waste dumps, sludge plants, oil and gas well drilling sites, and tanks and cesspools. If you are exposed to lower concentrations of hydrogen sulfide, the symptoms that appear, such as eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs, will usually subside within a few weeks, but other changes such as memory problems may occur. Breathing in hydrogen sulfide on a long-term basis may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness.

Very little information is available on what happens when you drink or eat something with hydrogen sulfide in it, but there are no reports of humans poisoned by such exposures. Pigs that ate food containing hydrogen sulfide experienced diarrhea for a few days and lost weight after a period of about 105 days.

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Little information is available on what happens when you are exposed to hydrogen sulfide by getting it on your skin, although care must be taken with the liquefied product to avoid frost bite. It is known that hydrogen sulfide will irritate your eyes if you are exposed to the gas. These types of exposures are more common in certain occupational settings.

Hydrogen sulfide has not been shown to cause cancer in humans, and its possible ability to cause cancer in animals has not been studied thoroughly. Hydrogen sulfide has not been classified for its ability to cause or not cause cancer. There is some evidence that exposure to hydrogen sulfide may lead to an increase in spontaneous abortions in humans. However, the studies where this effect was reported are complicated by exposures to other chemicals and a lack of information on the amount of exposure to hydrogen sulfide.

1.6 HOW CAN HYDROGEN SULFIDE AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans. Potential effects on children resulting from exposures of the parents are also considered.

Children are likely to be exposed to hydrogen sulfide in the same manner as adults with the exception of adults at work. However, because hydrogen sulfide is heavier than air and because children are shorter than adults, children may be exposed to larger amounts of hydrogen sulfide than adults. Health effects in children that have been exposed to hydrogen sulfide have not been studied much. It is likely that exposed children will experience effects similar to exposed adults. It is not known whether children are more sensitive to hydrogen sulfide exposure than adults and is not known whether hydrogen sulfide causes birth defects in humans. For more information on the potential health effects of hydrogen sulfide on children see Sections 2.6 and 5.6.

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1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO HYDROGEN SULFIDE?

If your doctor finds that you have been exposed to significant amounts of hydrogen sulfide, ask whether children may also be exposed. When necessary your doctor may need to ask your State Department of Public Health to investigate.

Families can become exposed to excess hydrogen sulfide if they live near natural or industrial sources of hydrogen sulfide such as hot springs, manure holding tanks, or pulp and paper mills. Families may wish to keep visits to such places to a minimum.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO HYDROGEN SULFIDE?

In the case of life-threatening hydrogen sulfide poisoning, measurements of blood sulfide or urinary thiosulfate levels may be used to confirm exposure. However, samples need to be taken within two hours of exposure in order to be useful. The tests for measuring sulfide in the blood or thiosulfate in the urine are described in Section 2.7.1.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

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Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals, then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an S-hour workday or a 24-hour day), the use of different animal studies. or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for hydrogen sulfide include the following:

EPA has established that hydrogen sulfide is a regulated toxic substance and is a hazardous substance as defined under the Federal Water Pollution Control Act. OSHA has established an acceptable ceiling concentration of 20 parts per million (ppm) for hydrogen sulfide in the workplace, with a maximum level of 50 ppm allowed for 10 minutes maximum duration if no other measurable exposure occurs. NIOSH has set a maximum Recommended Exposure Limit REL) ceiling value (10 minutes) of 10 ppm. A complete listing of federal and state regulations and recommendations are found in Chapter 7.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333

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* Information line and technical assistance

Phone: l-800-447-1544
Fax: (404) 639-6359

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

* To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: (800) 553-6847 or (703) 487-4650